

CLAIMS

What is claimed is:

1. A method of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that:

a data string of a code vector is made with reference to one or more units of data in the data string constituting the code vector, by giving, to the remaining units of data in the data string, values which vary from the reference data value in order by a predetermined increment.

2. A method of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that:

a data string of a code vector is made by the manner that the data string constituting the code vector is classified into data groups, the total range of the possible values of the respective units of data in the data string is divided by the number of classified data groups, and an arbitrary value in the divided range corresponding to the data group is selectively assigned as each data value in each data group.

3. A method of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at

least one unit of data, characterized in that:

a data string of a code vector is made by the manner that the occupation rate of the maximum or minimum value of the possible values of the respective units of data in the data string constituting the code vector is set, the maximum or minimum value is assigned to arbitrary units of data constituting the data string in accordance with the set rate, and the minimum or maximum value is assigned to the other units of data than the units of data to which the maximum or minimum value is assigned.

4. A method of making a code book used in vector quantization according to claim 3, characterized in that an intermediate value is assigned to predetermined units of data in accordance with the arrangement state of the units of data to which the minimum value is assigned.

5. A method of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that:

said method includes at least two of:

a first making method in which a data string of a code vector is made with reference to one or more units of data in the data string constituting the code vector, by giving, to the remaining units of data in the data string, values which vary from the

reference data value in order by a predetermined increment;

a second making method in which a data string of a code vector is made by the manner that the data string constituting the code vector is classified into data groups, the total range of the possible values of the respective units of data in the data string is divided by the number of classified data groups, and an arbitrary value in the divided range corresponding to the data group is selectively assigned as each data value in each data group; and

a third making method in which a data string of a code vector is made by the manner that the occupation rate of the maximum or minimum value of the possible values of the respective units of data in the data string constituting the code vector is set, the maximum or minimum value is assigned to arbitrary units of data constituting the data string in accordance with the set rate, the minimum or maximum value is assigned to the other units of data than the units of data to which the maximum or minimum value is assigned, and an intermediate value is assigned to predetermined units of data in accordance with the arrangement state of the units of data to which the minimum value is assigned; and

code books made by at least two of the first to third making methods are combined to make one code book.

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6. An apparatus for making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized by comprising:

reference value setting means for setting a reference data value to one or more arbitrary units of data in a data string constituting a code vector;

increment setting means for setting an increment with respect to the reference data value; and

code vector making means for making the data string of the code vector as a set of data values obtained by sequentially changing the set reference data value by the set increment.

7. An apparatus for making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized by comprising:

data classifying means for classifying a data string constituting a code vector into data groups;

range dividing means for dividing the total range of the possible values of the respective units of data in the data string by the number of classified data groups; and

code vector making means for making the data string of the code vector by selectively assigning, as each data value in each classified data group, an

arbitrary value in the divided range corresponding to the data group.

8. An apparatus for making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized by comprising:

rate setting means for, in a data string constituting a code vector, setting the occupation rate of the maximum or minimum value of the possible values of the respective units of data in the data string; and

code vector making means for making the data string of the code vector by assigning the maximum or minimum value to arbitrary units of data constituting the data string in accordance with the set rate and assigning the minimum or maximum value to the other units of data than the units of data to which the maximum or minimum value is assigned.

9. An apparatus for making a code book used in vector quantization according to claim 8, characterized in that said code vector making means assigns an intermediate value to predetermined units of data in accordance with the arrangement state of the units of data to which the minimum value is assigned.

10. An apparatus for making a code book used in vector quantization, characterized by comprising

means for making one code book by combining code books made by the code vector making means according to any two of claims 6 to 8.

11. A computer-readable recording medium which stores a program of a procedure of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that

 said recording medium records a program for causing a computer to execute a procedure of, with reference to one or more units of data in a data string constituting a code vector, making the data string of the code vector by giving, to the remaining units of data in the data string, values which vary from the reference data value in order by a predetermined increment.

12. A computer-readable recording medium which stores a program of a procedure of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that

 said recording medium records a program for causing a computer to execute a procedure of making a data string of a code vector by classifying the data string constituting the code vector into data groups, dividing the total range of the possible values of

the respective units of data in the data string by the number of classified data groups, and selectively assigning, as each data value in each data group, an arbitrary value in the divided range corresponding to the data group.

13. A computer-readable recording medium which stores a program of a procedure of making a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, characterized in that

 said recording medium records a program for causing a computer to execute a procedure of making a data string of a code vector by, in the data string constituting the code vector, setting the occupation rate of the maximum or minimum value of the possible values of the respective units of data in the data string, assigning the maximum or minimum value to arbitrary units of data constituting the data string in accordance with the set rate, and assigning the minimum or maximum value to the other units of data than the units of data to which the maximum or minimum value is assigned.

14. A computer-readable recording medium according to claim 13, characterized in that said recording medium records a program for causing the computer to execute a procedure of assigning an intermediate value to predetermined units of data in

accordance with the arrangement state of the units of data to which the minimum value is assigned.

15. A computer-readable recording medium which records a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, and having a data structure in which, with reference to one or more units of data, one code vector is constituted by a set of data values which vary from the reference data value in order by a predetermined increment.

16. A computer-readable recording medium which records a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of data, and having a data structure in which one code vector is constituted by classifying a data string constituting a code vector into data groups, dividing the total range of the possible values of the respective units of data in the data string by the number of classified data groups, and selectively assigning, as each data value in each data group, an arbitrary value in the divided range corresponding to the data group.

17. A computer-readable recording medium which records a code book used in vector quantization, said code book comprising a set of code vectors each of which is a data string including at least one unit of

data, and having a data structure in which one code vector is constituted by, in a data string constituting a code vector, setting the occupation rate of the maximum or minimum value of the possible values of the respective units of data in the data string, assigning the maximum or minimum value to arbitrary units of data constituting the data string in accordance with the set rate, assigning the minimum or maximum value to the other units of data than the units of data to which the maximum or minimum value is assigned, and assigning an intermediate value to predetermined units of data in accordance with the arrangement state of the units of data to which the minimum value is assigned.

18. An apparatus for making a code book used in vector quantization, said code book comprising a set of vectors each of which is a data string including at least one unit of data, characterized by comprising:

solid pattern generating means for generating at least one type of solid pattern code whose data value gradually varies in a block constituting the vector; and

edge pattern generating means for generating at least one type of edge pattern code whose data value abruptly varies in the block.

19. An apparatus for making a code book used in vector quantization according to claim 18,

characterized by comprising storage means for storing the pattern codes generated by said solid pattern generating means and said edge pattern generating means, and

code calculating means for, in executing the vector quantization, performing arithmetic operation for the pattern codes stored in said storage means to generate pattern codes different from the pattern codes.

20. An apparatus for making a code book used in vector quantization according to claim 18 or 19, characterized in that said solid pattern generating means generates a pattern code whose data value gradually varies from an arbitrary side and an arbitrary corner in the block to the opposite side and corner.

21. An apparatus for making a code book used in vector quantization according to any one of claims 18 to 20, characterized in that said solid pattern generating means generates a pattern code in which all data values in the block are constituted by values smaller or larger than an intermediate value of a possible range.

22. An apparatus for making a code book used in vector quantization according to any one of claims 18 to 21, characterized in that said solid pattern generating means generates pattern codes for which degrees of gradual changes are the same, and data

values themselves are different.

23. An apparatus for making a code book used in vector quantization according to claim 18 or 19, characterized in that said edge pattern generating means comprises

pattern input means for inputting a reference pattern, and

quantizing means for expressing the input reference pattern only by a predetermined data value group.

24. An apparatus for making a code book used in vector quantization according to claim 18, 19, or 23, characterized in that said edge pattern generating means generates pattern codes for which the differences between data values in the block are the same, and data values themselves are different.

25. An apparatus for making a code book used in vector quantization according to claim 24, characterized in that said edge pattern generating means generates, in addition to the pattern codes for which the differences between data values in the block are the same, pattern codes for which difference ratios are the same, and the data values themselves are different.

26. An apparatus for making a code book used in vector quantization according to claim 19, characterized in that said code calculating means performs at least one of arithmetic operations of

block rotation processing and data value inversion processing for each pattern code stored in said storage means.

27. A method of making a code book used in vector quantization, said code book comprising a set of vectors each of which is a data string including at least one unit of data, characterized in that:

at least one type of solid pattern code whose data value gradually varies in a block constituting a vector and at least one type of edge pattern code whose data value abruptly varies in the block, are generated as basic patterns and stored in storage means; and

in executing the vector quantization, pattern codes different from the basic patterns are generated by performing arithmetic operation for the pattern codes stored in the storage means.

28. A method of making a code book used in vector quantization according to claim 27, characterized in that, before execution of the vector quantization, a solid pattern code whose data value gradually varies from an arbitrary side in the block to the opposite side and a solid pattern code whose data value gradually varies from an arbitrary corner in the block to the opposite corner are generated as the basic patterns and stored in the storage means.

29. A method of making a code book used in vector quantization according to claim 27,

characterized in that that, before execution of the vector quantization, the edge pattern code is generated by inputting a reference pattern and at least executing quantization processing of expressing the input reference pattern only by a predetermined data value, and stored in the storage means as the basic pattern.

30. A method of making a code book used in vector quantization according to claim 27, characterized in that, in executing the vector quantization, at least one of arithmetic operations of block rotation processing and data value inversion processing is performed for each pattern code stored in the storage means.

31. A vector quantizing device which forms, as a vector, a block from a data string including at least one unit of data, searches for a code vector similar to the vector extracted from a compression target from a code book prepared in advance, and outputs a code corresponding to the code vector, characterized by comprising:

solid pattern generating means for generating at least one type of solid pattern code whose data value gradually varies in the block;

edge pattern generating means for generating at least one type of edge pattern code whose data value abruptly varies in the block;

storage means for storing the pattern codes

generated by said solid pattern generating means and said edge pattern generating means;

code calculating means for, in executing the vector quantization, performing arithmetic operation for the pattern codes stored in said storage means to generate pattern codes different from the pattern codes; and

vector quantizing means for executing the vector quantization using the pattern codes read out from said storage means and the pattern codes generated by said code calculating means.

32. A method of making a code book used in vector quantization, said code book comprising a set of vectors each of which is a data string including at least one unit of data, characterized in that:

at least one type of solid pattern code is generated in advance as a basic pattern and stored in storage means; and

in executing the vector quantization, a pattern code different from the basic pattern is generated by performing arithmetic operation for the at least one type of pattern code which is stored in the storage means.

33. A method of making a code book used in vector quantization according to claim 32, characterized in that the arithmetic operation is at least one of rotation processing and data value inversion processing.

34. A computer-readable recording medium characterized in that said recording medium records a program for causing a computer to execute a processing procedure of the code book making method according to claim 32 or 33.

35. A vector quantizing device which forms, as a vector, a block from a data string including at least one unit of data, searches for a code vector similar to the vector extracted from a compression target from a code book prepared in advance, and outputs a code corresponding to the code vector, characterized by comprising:

storage means for storing the code book;
calculating means for, in executing the vector quantization, performing arithmetic operation for codes stored in said storage means to generate codes different from the stored codes; and

vector quantizing means for executing the vector quantization using the codes read out from said storage means and the codes generated by said calculating means.

36. A vector quantizing device used in vector quantization according to claim 35, characterized in that arithmetic operation by said calculating means is at least one of rotation processing and data value inversion processing.

37. A computer-readable recording medium which records a vector quantization program for forming, as

a vector, a block from a data string including at least one unit of data, searching for a code vector similar to the vector extracted from a compression target from a code book prepared in advance, and outputting a code corresponding to the code vector, characterized in that said computer-readable recording medium records a program for causing a computer to execute:

the calculating step of, in executing the vector quantization, performing arithmetic operation for codes stored in storage means to generate codes different from the stored codes; and

the vector quantizing step of executing the vector quantization using the codes read out from the storage means and the codes generated in the calculating step.

38. A computer-readable recording medium according to claim 37, characterized in that, as arithmetic operation in the calculating step, at least one of rotation processing and data value inversion processing is performed.

39. A device for data compression, which forms, as a vector, a block from a data string including at least one unit of data, searches for a code vector similar to the vector extracted from a compression target from a code book prepared in advance, and outputs a code corresponding to the code vector, characterized by comprising:

code book storage means for storing a code book prepared for every different type of pattern;

discriminating means for discriminating a type of pattern of data of the block on the basis of information in the block of the compression target; and

vector quantizing means for executing vector quantization processing using the code books prepared for the respective patterns in accordance with a discrimination result by said discriminating means.

40. A device for data compression according to claim 39, characterized in that said discriminating means discriminates, on the basis of data values of elements in the block of the compression target, between a first pattern whose data value gradually varies in a certain direction in the block and a second pattern whose data value abruptly varies in the block.

41. A device for data compression according to claim 40, characterized in that said discriminating means discriminates the block as the first pattern when the difference between the maximum and minimum values of the elements in the block is smaller than a predetermined threshold value, and discriminates the block as the second pattern when the difference between the maximum and minimum values in the block is larger than the predetermined threshold value.

42. A device for data compression according to

any one of claims 39 to 41, characterized in that said vector quantizing means obtains similarity for the blocks of different types of patterns by different processes.

43. A device for data compression according to claim 42, characterized in that, for the first pattern in which the data value of each element in the block of the compression target gradually varies, said vector quantizing means obtains the similarity using only data values of elements at the four corners in a rectangular block.

44. A device for data compression according to claim 43, characterized in that said vector quantizing means detects a direction of data value change in the block from the data values at the four corners in the block and searches for the similar code vector also in consideration of the direction.

45. A device for data compression according to claim 43 or 44, characterized in that each code vector constituting the code book for the first pattern has only pieces of information on the elements at the four corners in the block.

46. A device for data decompression which uses a data string including at least one unit of data as a vector, searches for a code vector corresponding to a compression code from a code book including at least one code vector, and assigns the code vector to a corresponding block position to reconstruct original

data, characterized by comprising:

code book storage means for storing a code book prepared for every different type of pattern; and

decoding means for, on the basis of compression codes generated on the compressing side for the respective patterns of different types, searching for code vectors corresponding to the compression codes from the code books prepared for the respective patterns.

47. A device for data decompression according to claim 46, characterized in that the different types of patterns include a first pattern in which the data value of each element in the block of the compression target gradually varies in a certain direction in the block and a second pattern in which the data value abruptly varies in the block.

48. A device for data decompression according to claim 47, characterized in that each code vector constituting the code book for the first pattern has only pieces of information on the elements at the four corners in the rectangular block.

49. A device for data decompression according to claim 48, characterized by further comprising calculating means for calculating, by arithmetic operation, pieces of information on the other elements on the basis of pieces of information on the elements at the four corners in the block.

50. A method for data compression in which a

block is formed, as a vector, from a data string including at least one unit of data, a code vector similar to the vector extracted from a compression target is searched from a code book prepared in advance, and a code corresponding to the code vector is output, characterized in that:

a type of pattern of data in the block of the compression target is discriminated on the basis of information in the block and vector quantization processing is executed using code books prepared for the respective patterns in accordance with a discrimination result.

51. A method for data decompression according to claim 50, characterized in that the different types of patterns include a first pattern in which the data value of each element in the block of the compression target gradually varies in a certain direction in the block and a second pattern in which the data value abruptly varies in the block.

52. A method for data compression according to claim 51, characterized in that, in executing the vector quantization processing, for the blocks of the patterns of different types, similarities of vectors are obtained by different processes, and, for the first pattern, the similarity is obtained using only data values of elements at the four corners in a rectangular block.

53. A method for data compression according to

claim 52, characterized in that a direction of data value change is detected in the block from the data values at the four corners in the block and the similar code vector is searched also in consideration of the direction.

54. A method for data decompression in which a data string including at least one unit of data is used as a vector, a code vector corresponding to a compression code is searched from a code book including at least one code vector, and the code vector is assigned to a corresponding block position to reconstruct original data, characterized in that:

on the basis of compression codes generated on the compressing side for the respective different types of patterns, code vectors corresponding to the compression codes are searched from code books prepared for the respective patterns.

55. A method for data decompression according to claim 54, characterized in that the different types of patterns include a first pattern in which the data value of each element in the block of the compression target gradually varies in a certain direction in the block and a second pattern in which the data value abruptly varies in the block.

56. A method for data decompression according to claim 55, characterized in that each code vector constituting the code book for the first pattern has only pieces of information on the elements at the

four corners in a rectangular block, and, in searching for the code vector corresponding to the compression code and assigning the code vector to the corresponding block position, by arithmetic operation, pieces of information on the other elements are calculated on the basis of pieces of information on the elements at the four corners in the block.

57. A system for data compression/decompression including a device for data compression which forms, as a vector, a block from a data string including at least one unit of data, searches for a code vector similar to the vector extracted from a compression target from a code book prepared in advance, and outputs a code corresponding to the code vector, and a device for data decompression which searches for a code vector corresponding to the code from the code book and assigns the code vector to a corresponding block position to reconstruct original data, characterized in that

 said device for data compression comprises first code book storage means for storing a code book prepared for every different type of pattern,

 discriminating means for discriminating a type of pattern of data of the block on the basis of information in the block of the compression target, and

 vector quantizing means for executing vector quantization processing using the code books prepared

for the respective patterns in accordance with a discrimination result by said discriminating means; and

 said device for data decompression comprises second code book storage means for storing a code book prepared for every different type of pattern, and

 decoding means for, on the basis of compression codes generated on the compressing side for the respective patterns of different types, searching for code vectors corresponding to the compression codes from the code books prepared for the respective patterns.

58. A system for data compression/decompression according to claim 57, characterized in that each of said first and second code book storage means stores the code books of the different types of patterns in a single storage device.

59. A system for data compression/decompression according to claim 57, characterized in that each of said first and second code book storage means separately stores the code books of the different types of patterns in storage devices, and

 information for identifying a pattern is supplied to said device for data decompression together with the code generated by said device for data compression.

60. A computer-readable recording medium

characterized in that said recording medium stores a program for causing a computer to function as each means according to claim 39.

61. A computer-readable recording medium characterized in that said recording medium stores a program for causing a computer to realize the function according to any one of claims 40 to 44.

62. A computer-readable recording medium characterized in that said recording medium stores a program for causing a computer to function as each means according to claim 46 or 49.

63. A computer-readable recording medium characterized in that said recording medium stores a program for causing a computer to execute a processing procedure of the method for data compression according to any one of claims 50 to 53.

64. A computer-readable recording medium characterized in that said recording medium stores a program for causing a computer to execute a processing procedure of the method for data decompression according to any one of claims 54 to 56.